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Czompo

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(54) **CONCURRENT DATA STREAMING USING VARIOUS PARAMETERS FROM THE SAME SENSOR**

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H04M 1/725	(2006.01)

(Continued)

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See application file for complete search history.

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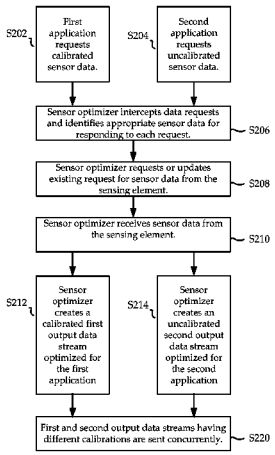
(57) **ABSTRACT**

Embodiments implement a device having a sensor optimizer, where a source data stream from a sensor module may be used by the sensor optimizer to create multiple sensor data streams having different data stream parameters (e.g. data rate, calibration, scaling, etcetera) from the source data stream. Such a sensor optimizer may intercept requests for sensor data from applications running on a mobile device processor, and concurrently provide data streams having different data stream parameters to applications executed by the processor.

18 Claims, 7 Drawing Sheets



(51) **Int. Cl.**

G06F 3/038	(2013.01)
G06F 3/00	(2006.01)
G01C 25/00	(2006.01)
G06F 3/0346	(2013.01)

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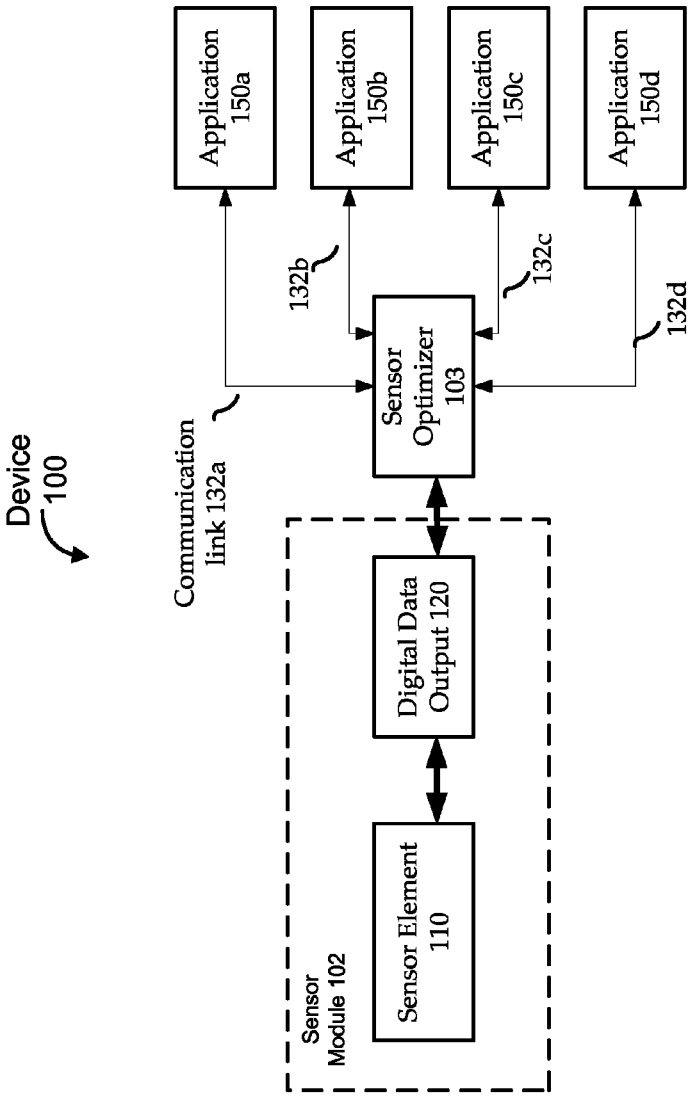
Device
100
Application
150a
Application
150b
Application
150c
Application
150d
132b
132c
132d
Communication
link 132a
Sensor
Optimizer
103
Digital Data
Output 120
Sensor Element
110
Sensor
Module 102

FIG. 1

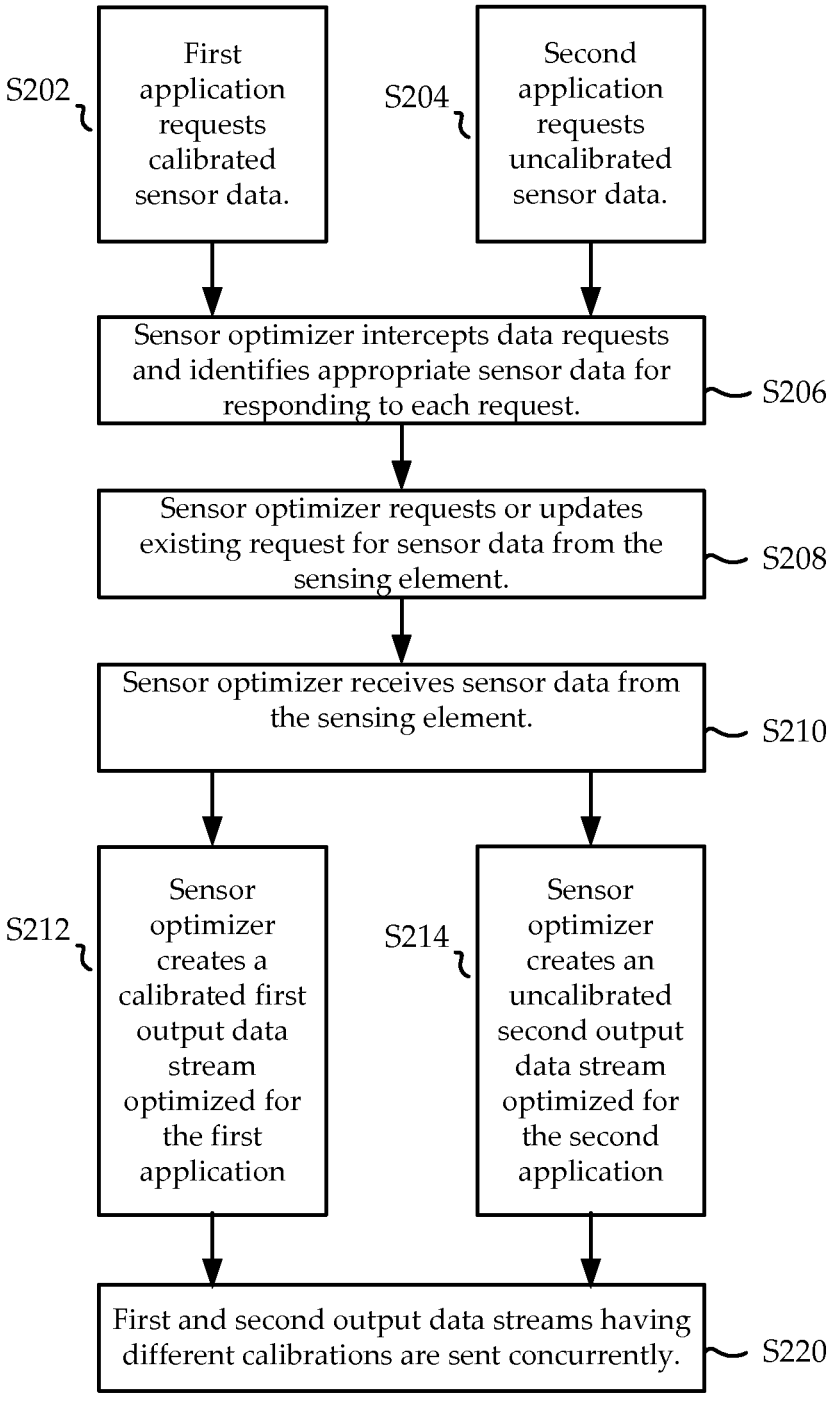
S202
First application requests calibrated sensor data.
S204
Second application requests uncalibrated sensor data.
Sensor optimizer intercepts data requests and identifies appropriate sensor data for responding to each request.
S206
Sensor optimizer requests or updates existing request for sensor data from the sensing element.
S208
Sensor optimizer receives sensor data from the sensing element.
S210
S212
Sensor optimizer creates a calibrated first output data stream optimized for the first application
S214
Sensor optimizer creates an uncalibrated second output data stream optimized for the second application
First and second output data streams having different calibrations are sent concurrently.
S220

FIG. 2

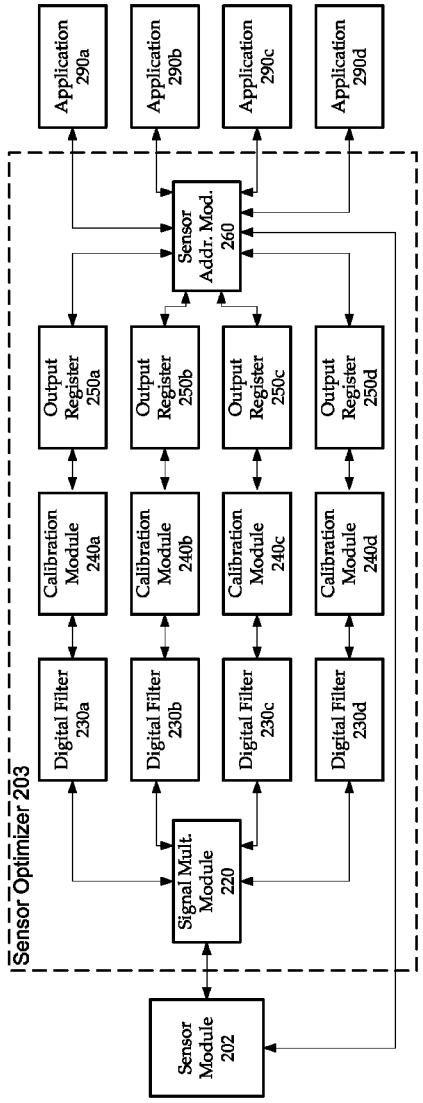
Application 290a
Application 290b
Application 290c
Application 290d
Device 200
Sensor Addr. Mod. 260
Output Register 250a
Output Register 250b
Output Register 250c
Output Register 250d
Calibration Module 240a
Calibration Module 240b
Calibration Module 240c
Calibration Module 240d
Digital Filter 230a
Digital Filter 230b
Digital Filter 230c
Digital Filter 230d
Signal Mult. Module 220
Sensor Optimizer 203
Sensor Module 202

FIG. 3

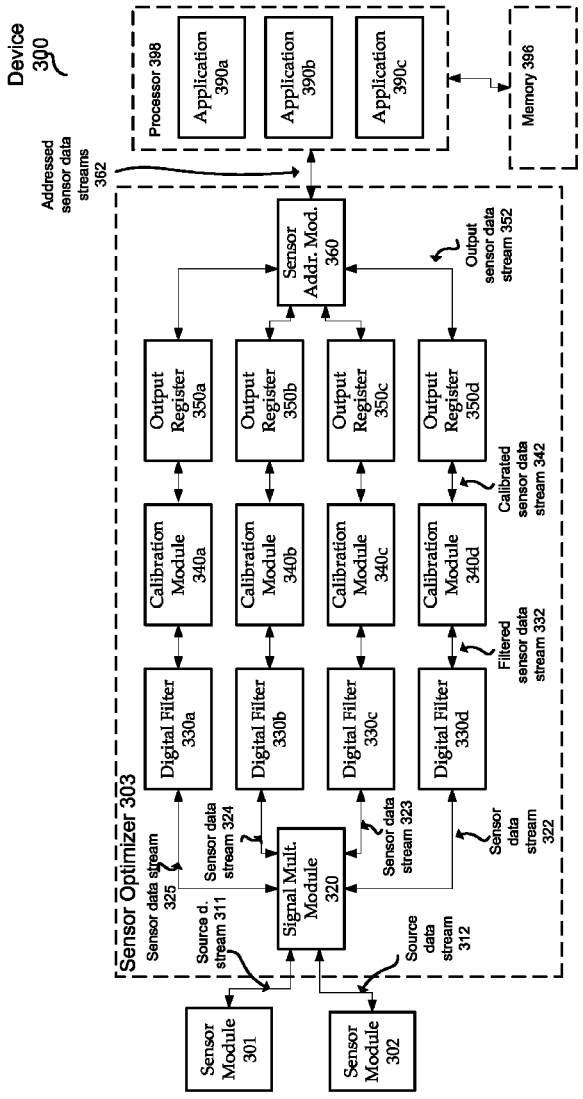
Device 390
Processor 398
Application 390a
Application 390b
Application 390c
Memory 396
Addressed sensor data streams 362
Sensor Addr. Mod. 360
Output sensor data stream 352
Output Register 350a
Output Register 350b
Output Register 350c
Output Register 350d
Calibration Module 340a
Calibration Module 340b
Calibration Module 340c
Calibration Module 340d
Calibrated sensor data stream 342
Digital Filter 330a
Digital Filter 330b
Digital Filter 330c
Digital Filter 330d
Filtered sensor data stream 332
Sensor Optimizer 303
Sensor data stream 325
Sensor data stream 324
Sensor data stream 323
Sensor data stream 322
Signal Mult. Module 320
Source d. stream 311
Source data stream 312
Sensor Module 301
Sensor Module 302

FIG. 4

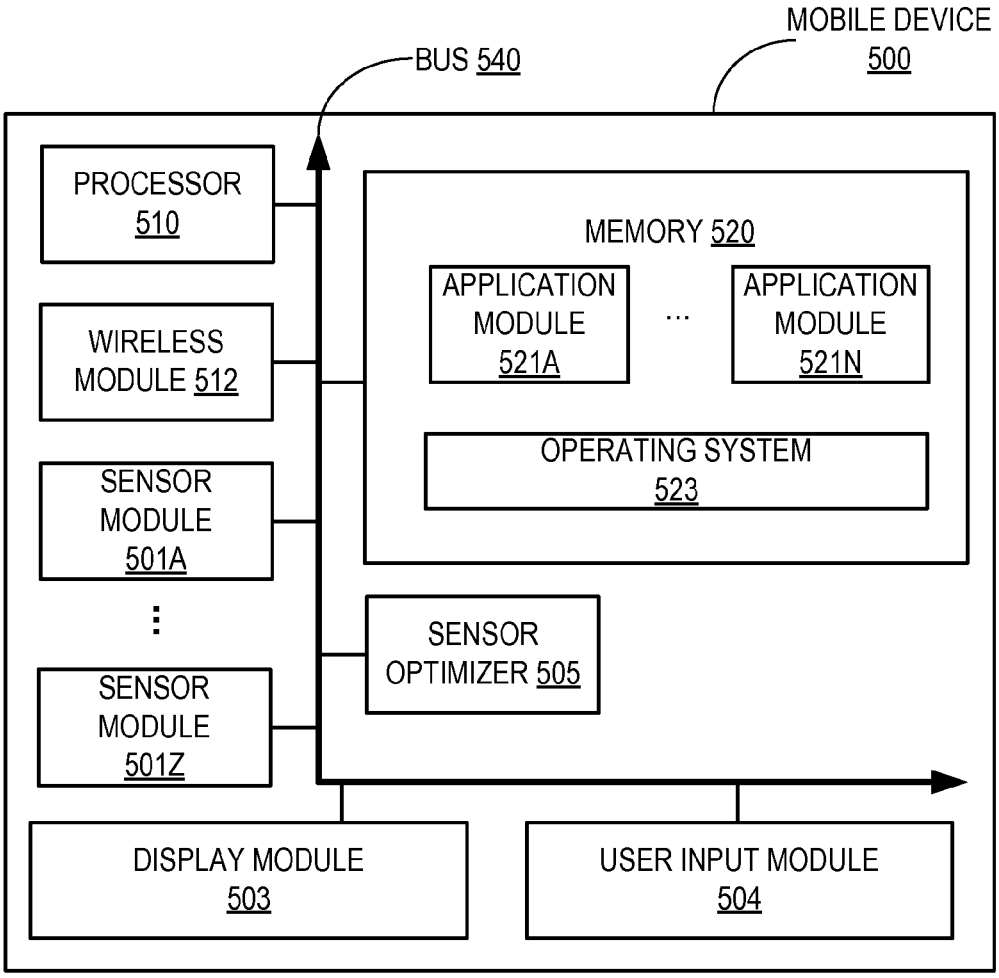
MOBILE DEVICE
500
BUS 540
PROCESSOR
510
WIRELESS
MODULE 512
SENSOR
MODULE
501A
SENSOR
MODULE
501Z
MEMORY 520
APPLICATION
MODULE
521A
APPLICATION
MODULE
521N
OPERATING SYSTEM
523
SENSOR
OPTIMIZER 505
DISPLAY MODULE
503
USER INPUT MODULE
504

FIG. 5

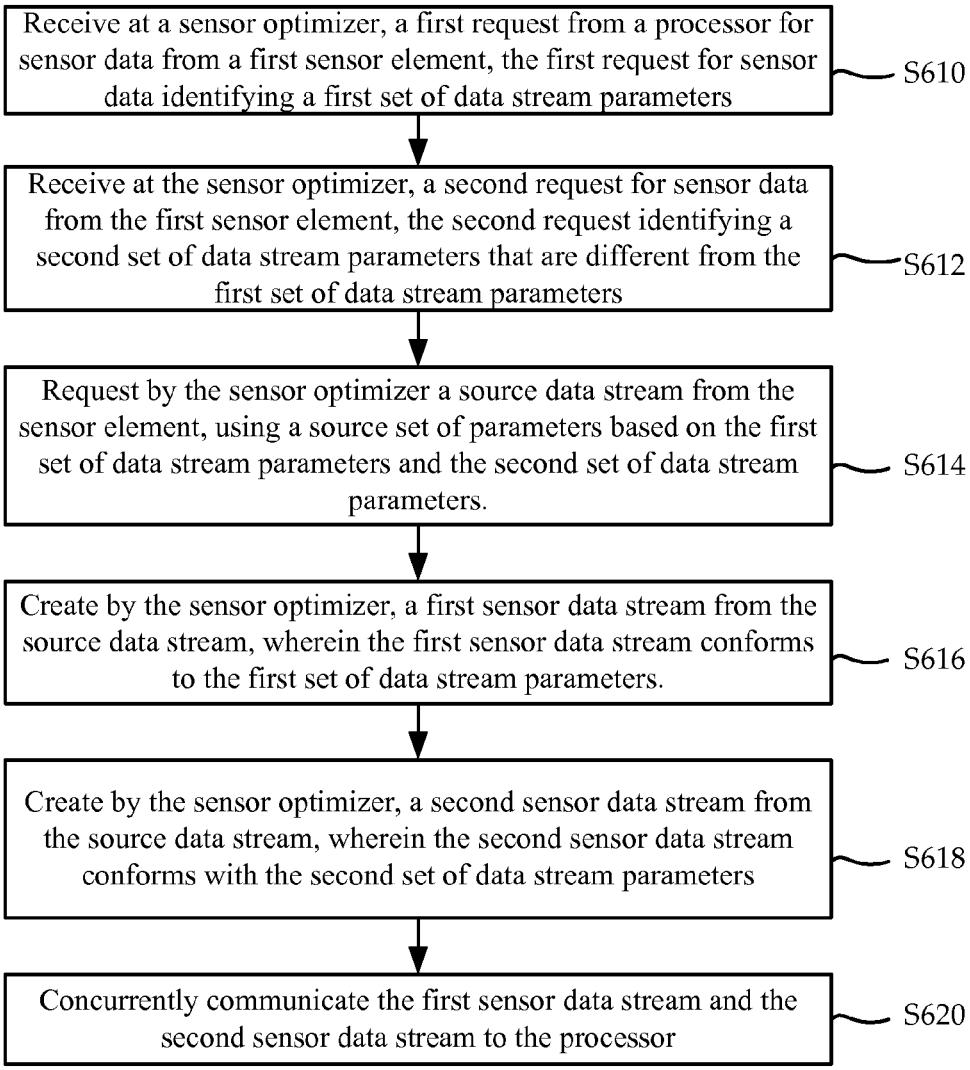
Receive at a sensor optimizer, a first request from a processor for sensor data from a first sensor element, the first request for sensor data identifying a first set of data stream parameters
S610
Receive at the sensor optimizer, a second request for sensor data from the first sensor element, the second request identifying a second set of data stream parameters that are different from the first set of data stream parameters
S612
Request by the sensor optimizer a source data stream from the sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters.
S614
Create by the sensor optimizer, a first sensor data stream from the source data stream, wherein the first sensor data stream conforms to the first set of data stream parameters.
S616
Create by the sensor optimizer, a second sensor data stream from the source data stream, wherein the second sensor data stream conforms with the second set of data stream parameters
S618
Concurrently communicate the first sensor data stream and the second sensor data stream to the processor
S620

FIG. 6

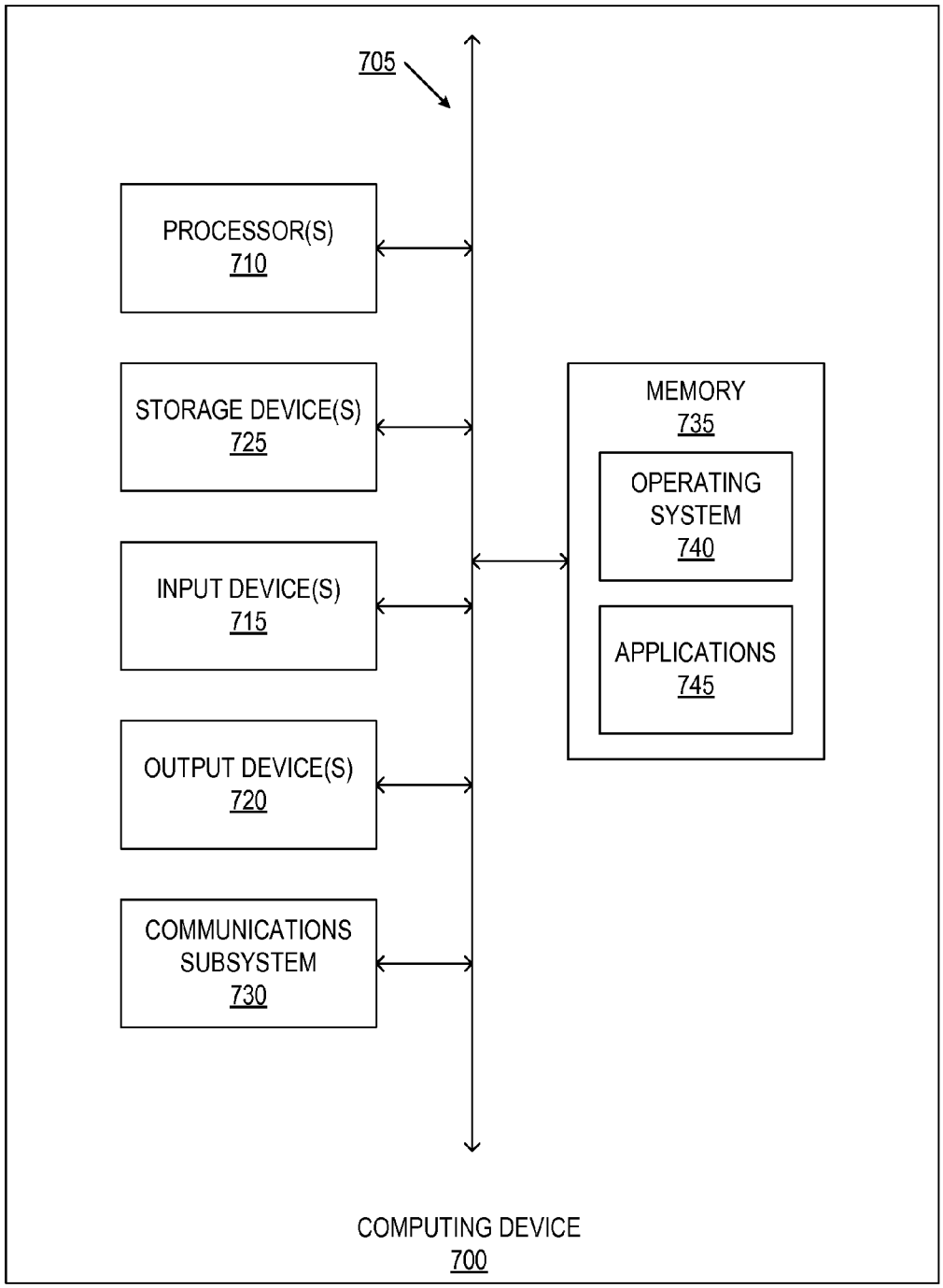
705
PROCESSOR(S)
710
STORAGE DEVICE(S)
725
INPUT DEVICE(S)
715
OUTPUT DEVICE(S)
720
COMMUNICATIONS SUBSYSTEM
730
MEMORY
735
OPERATING SYSTEM
740
APPLICATIONS
745
COMPUTING DEVICE
700

FIG. 7

CONCURRENT DATA STREAMING USING VARIOUS PARAMETERS FROM THE SAME SENSOR

CROSS-REFERENCE

This application claims priority from U.S. Provisional Patent Application No. 61/672,677 filed Jul. 17, 2012, entitled "CONCURRENT DATA STREAMING USING VARIOUS PARAMETERS FROM THE SAME SENSOR", which is hereby incorporated by reference, as if set forth in full in this document, for all purposes.

BACKGROUND

Aspects of the disclosure relate sensors. In particular, devices, systems, and methods for sensors having multiple output data streams with different data stream parameters for the different output data streams from the same sensor. Particular embodiments integrated with a mobile device such as a smart phone where multiple applications operating on the smart phone request information with different data stream parameters from the same sensor are provided.

Current mobile phones are frequently integrated with sensors. Examples of sensors may be light sensors such as cameras, or movement sensors such as accelerometers. Such sensors as currently structured within mobile devices are capable of outputting a single sensor data stream. Additional manipulation of the data in the sensor data stream will then be performed as part of a separate function or application of the mobile device. The single sensor data stream may be copied and altered by a processor of the mobile device, but the sensor module itself outputs a single data stream.

As the power of mobile devices such as smart phones increase, greater and more diverse types of applications are operated on such mobile devices, and there is therefore a growing need for new and useful techniques and structures for providing sensor data for sensors integrated in mobile devices.

BRIEF SUMMARY

Various embodiments described herein include devices, systems, and methods for sensors having multiple output data streams with different data stream parameters for the different output data streams from the same sensor. For example, one potential embodiment is a method comprising: receiving, at a sensor optimizer, a first request from a processor for sensor data from a first sensor element, the first request for sensor data identifying a first set of data stream parameters; receiving, at the sensor optimizer, a second request for sensor data from the first sensor element, the second request identifying a second set of data stream parameters that are different from the first set of data stream parameters; requesting, by the sensor optimizer, a source data stream from the first sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters; creating, by the sensor optimizer, a first sensor data stream from the source data stream, wherein the first sensor data stream conforms to the first set of data stream parameters; creating, by the sensor optimizer, a second sensor data stream from the source data stream, wherein the second sensor data stream conforms with the second set of data stream parameters; and concurrently communicating the first sensor data stream and the second sensor data stream to the processor.

Another potential method according to such an embodiment may function where the first request for sensor data comprises including a request for calibrated data; wherein the first sensor data stream conforms to the first set of data stream parameters and comprises the calibrated data.

Another potential method according to such an embodiment may additionally function where the second request for sensor data comprises a request for uncalibrated data; wherein the second sensor data stream conforms with the second set of data stream parameters and comprises the uncalibrated data. Another potential method according to such an embodiment may additionally function where the first request for sensor data is received from a first application operating on the processor and wherein the second request for sensor data is received from the first application operating on the processor.

Another potential method according to such an embodiment may additionally function where the first request for sensor data is received from a first application operating on the processor and wherein the second request for sensor data is received from a second application operating on the processor.

Another potential method according to such an embodiment may additionally function where the first application comprises a camera application and the second application comprises a navigation application. Another potential method according to such an embodiment may additionally function where the first sensor element comprises a gyroscope. Another potential method according to such an embodiment may additionally function where the first sensor element comprises an accelerometer.

Another potential method according to such an embodiment may additionally function where the first application comprises a user interface orientation control application and wherein the second application comprises a navigation application. Another potential method according to such an embodiment may additionally function where the first request for sensor data is received from a first application operating on the processor and wherein the second request for sensor data is received from a second application operating on a second processor within a mobile device that comprises the processor.

Another potential method according to such an embodiment may additionally function where creating the first sensor data stream and the second sensor data stream comprises: receiving the source data stream from the first sensor element at a signal multiplexing module of the sensor optimizer; outputting the first sensor data stream from the signal multiplexing module to a first output register of the sensor optimizer; and outputting the second sensor data stream from the signal multiplexing module to a second output register of the sensor optimizer.

Another potential method according to such an embodiment may additionally function where concurrently communicating the first sensor data stream to the first application and the second sensor data stream to the second application comprises: communicating the first sensor data stream from the first output register to the first application of the processor via a sensor addressing module beginning at a first time and ending at a second time; and communicating the second sensor data stream from the second output register to the second application of the processor via the sensor addressing module beginning at a third time and ending at a fourth time, wherein the third time is later than the first time and the third time is earlier than the second time.

Another potential embodiment may be a device comprising a first sensor module comprising a first sensor element;

a sensor optimizer coupled to the first sensor module; and a processor coupled to the first sensor module via the sensor optimizer; wherein the sensor optimizer receives a source sensor data stream from the first sensor module and concurrently outputs to the processor at least two sensor data streams derived from the source sensor data stream.

Another potential device according to such an embodiment may additionally function where the sensor optimizer comprises: a plurality of digital filters coupled to the first sensor element by a signal multiplexing module; a plurality of output registers, each output register coupled to one corresponding digital filter of the plurality of digital filters; and a sensor addressing module coupled to the plurality of output registers.

Another potential device according to such an embodiment may additionally function where the sensor optimizer further comprises a first calibration module;

wherein the plurality of digital filters comprises a first digital filter and a second digital filter; wherein the processor executes a plurality of applications, each application of the plurality of applications providing a set of data stream parameters to the processor for communication to the sensor addressing module as part of a request for sensor data by each application of the plurality of applications; wherein the plurality of output registers comprises a first output register coupled to the first digital filter and a second output register coupled to the second digital filter; and wherein the first digital filter is coupled to the first output register via the first calibration module

Another potential embodiment may be a device comprising: means for intercepting a source sensor data stream from a sensor module; means for creating at least two different sensor data streams derived from the source sensor data stream; and means for concurrently outputting the at least two different sensor data streams to a processor.

Another potential device according to such an embodiment may additionally comprise means for intercepting requests for sensor data streams from the processor to the sensor module; and means for adjusting a set of sensor stream parameters for each sensor data stream to match requested sensor stream parameters from the intercepted requests for sensor data streams.

Another potential device according to such an embodiment may additionally comprise means for intercepting a second source data stream from a second sensor module; means for creating second at least two different sensor data streams derived from the second source sensor data stream; and means for concurrently outputting the second at least two different sensor data streams to the processor.

Another embodiment may be a non-transitory computer readable storage medium comprising computer readable instructions that, when executed by a processor coupled to the storage medium, cause a device to perform a method comprising: communicating from the processor to a sensor optimizer, a first request for sensor data from a first sensor element, the first request for sensor data identifying a first set of data stream parameters; communicating from the processor to the sensor optimizer, a second request for sensor data from the first sensor element, the second request identifying a second set of data stream parameters that are different from the first set of data stream parameters; requesting, by the sensor optimizer, a source data stream from the first sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters; creating, by the sensor optimizer, a first sensor data stream from the source data stream, wherein the first sensor data stream conforms to the first set of data stream parameters; creating, by the sensor optimizer, a second sensor data stream from the source data stream, wherein the second sensor data stream conforms with the second set of data stream parameters; and concurrently receiving at the processor the first sensor data stream and the second sensor data stream.

Additional embodiments of such a non-transitory computer readable storage medium may function where the method further comprises: executing, by the processor, a first application that initiates the first request for sensor data; and executing, by the processor, a second application concurrent with the execution of the first application, wherein the second application initiates the second request for sensor data.

BRIEF DESCRIPTION OF THE DRAWINGS

A further understanding of the nature and advantages of various embodiments may be realized by reference to the following figures. In the appended figures, similar components or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label by a dash and a second label that distinguishes among the similar components. If only the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label.

FIG. **1** shows a diagram of a device according one potential embodiment.

FIG. **2** illustrates a method according to some embodiments.

FIG. **3** shows a diagram of a device according one potential embodiment.

FIG. **4** shows a diagram of a device according one potential embodiment.

FIG. **5** shows a diagram of a mobile device according one potential embodiment.

FIG. **6** illustrates a method according to some embodiments.

FIG. **7** illustrates an example computing system in which one or more aspects of the disclosure may be implemented.

DETAILED DESCRIPTION

The present innovations relate to sensors and electronic devices with integrated sensors. In particular, devices are described which may integrate a sensor element with a processor. The processor may operate multiple applications concurrently, with each application requesting information from the sensor element. Various embodiments may function to provide concurrent and distinct data streams that are tailored to different applications.

For example, in one potential embodiment, a smart phone having a navigation application and a camera application may operate the applications concurrently. The navigation application may use the gyroscope data to assist with providing directions by measuring movement of the device and updating directions as the device moves. The camera application may use gyroscope data for an image stabilization function. These two different uses may have differing requirements for the data. The image stabilization function of a camera application may work more effectively if a calibration is determined and corrected for continuously in real-time. The navigation application on the other hand may require uncalibrated data because real-time calibration and correction may introduce discontinuities or jumps into the

data which may degrade navigation performance. Additionally, the applications may require different data rates, or different settings for other parameters. Use of a single data stream to provide data for both devices may therefore create inefficiencies and/or performance degradation in one or both of the applications. According to various embodiments, a first data stream may be created with calibrated data creating a real time bias correction for image stabilization in the photography application, and a second data stream may be created with uncalibrated data for the navigation application, with each data stream having additional parameters that may or may not be different.

Another potential example is a device such as a phone or a tablet computer including an accelerometer as a sensor element, with a user interface orientation control application and a navigation application. The user interface orientation control application may request calibrated data at a lower frequency in order to present data to the device screen in the correct portrait-landscape orientation as a user rotates the device. A navigation application may request uncalibrated data at a higher frequency in order to assist in presenting directions to the user. A system able to create concurrent calibrated and uncalibrated data streams for these applications may provide improved application performance.

As described herein, a "sensor element" refers to any component of a device used to measure a physical characteristic and output a signal that describes that characteristic. One example of a sensor element includes a camera and other light detecting elements that convert light into an electronic signal. Another example includes accelerometers and elements that measure movement. A further example is a global positioning receiver that receives satellite signals in order to output an electronic signal identifying a location of the receiver functioning as the sensing element. A sensor element may be any such transceiver or measuring element.

As described herein, a "module" refers to a set of components integrated as part of a device to perform functions as a unit. Modules may include circuitry, software, firmware, or any combination of these to perform various functions. For example, a wireless module may include an antenna, and any firmware and software for basic functionality in sending and receiving signals using the antenna.

As describe herein, a "sensor module" refers to a set of integrated components including a sensor element that outputs the signal describing the characteristic measured by a sensor element. Such components integrated with the sensor element may include active components that format and buffer the signal from the sensor element in forms usable by a processing element. Examples of such components include analog to digital converters that may convert an analog signal output from a sensor element into a digital signal usable by a general purpose computing processor to perform specific algorithms implemented as applications in a device including a sensor module. In various sensor modules, sensor elements may be integrated with circuit components to create integrated system on a chip structures that are fabricated and attached to a single integrated circuit die which is directly coupled to the sensing element. In other sensor modules, a printed circuit board may include various components with the sensing element directly coupled to the components using conductive lines in the printed circuit board.

As described herein, a "data stream" refers to information output over time. For example, certain sensor elements may function to constantly output an analog signal as measurements of a physical characteristic of the environment of the sensor element are measured. The information being output as part of the constant output from the sensor element may be a sensor data stream. In various alternative embodiments, a data stream may be periodic, random, or associated with specific requests for information directed to a sensor module.

As described herein "concurrently output sensor streams" refers to multiple sensor streams for which data from at least a portion of each sensor stream is output at the same time as data from at least a portion of another sensor stream is output. The output of each sensor stream need not begin or end at the same time. This merely refers to data from a first sensor stream being output from a sensor module at the same time as data from a second sensor stream is output from a sensor module.

Referring to FIG. **1**, device **100** illustrates one potential non-limiting example of a device. Device **100** includes sensor **102** which may include sensor element **110** and digital data output **120**. Device **100** also includes sensor optimizer **103**, and applications **150***a-d*. Device **100** may additionally include communication links **132***a-d* communicatively coupling sensor optimizer **103** to respective applications **150***a-d*. Although four applications are shown in FIG. **1**, any number of two or more applications may function in accordance with various embodiments.

Sensor **102** may be any sensing device integrated with device **100** and includes a sensor element **110** for receiving information. For example, sensor **102** may be a gyroscope, an accelerometer, a magnetometer, a charge coupled device (CCD), a photovoltaic cell, any light sensing device, a temperature sensing device, a pressure sensing device, or any other potential sensing device or element.

Digital data output **120** may comprise an analog to digital converter for sensor elements that create analog data, and may further comprise digital filters, device calibration settings, biases, and scale factors. In various embodiments, sensor element **110** may be integrated with digital data output **120** as part of an integrated circuit or packaged electronic device that may then be further integrated into device **100**.

Sensor optimizer **103** may comprise a hardware module or a software module for receiving a data stream from sensor element **110** via digital data output **120**, and converting the single data stream from sensor element **110** into multiple data streams which may be communicated to applications **150** via communication links **132**. Similarly, both applications **150** and communication links **132** may be implemented as hardware modules, firmware module, software modules or as any combination of such modules. For example, in one potential embodiment, a device **100** may comprise a single processor such as processor **710** described in FIG. **3**. The single processor may implement sensor optimizer **103**, applications **150***a*, **150***b*, **150***c*, and **150***d*, and may further implement communication links **132***a*, **132***b*, **132***c*, and **132***d*. In alternate embodiments, sensor optimizer **103** may comprise an integrated circuit or device coupled to one or more processors or hardware modules that implement applications **150**. Communication links **132** may be one or more conductive lines within device **100**. Any module within device **100** may be implemented using hardware elements, firmware elements, software elements, or any combination of elements to implement the module.

FIG. **2** describes a method of implementing an embodiment. In step S**202** a first application **190***a* may request information regarding available data streams from sensor element **110**. Such a query may attempt to identify unused data streams which may have parameters adjusted to match the preferences of the first application, or may provide a set

of preferred parameters with a request to identify whether a data stream conforming to the identified parameters is available. In step S**204**, the first application **190***a* may receive a communication from sensor addressing module **160** identifying the availability of a data stream, and application **190***a* may communicate the request for the data along with the parameters.

In step S**206** a second application **190***b* operating in a device **100** may request sensor data and identify a set of parameters. Unlike application **190***a*, second application **190***b* may have no integrated system for acknowledging that multiple streams of data may exist. Instead, another module such as sensor addressing module **160** may receive the request, identify the availability of an appropriate data stream, set the corresponding digital filter **130** and calibration module **140** settings based on the request from application **190***b*, and communicate the data stream to application **190***b* in a way that is transparent to application **190***b*. These requests in S**204** and S**206** may occur at the same time, or may initially occur at separate times, such that one data stream may exist at the time another data stream is created in response to a request for sensor data. In various alternative embodiments, all or any combination of applications may function in a manner similar to that of application **190***a* described above. In other alternative embodiments, all or any combination of applications may function in a manner similar to that of application **190***b*. Additionally, in still further embodiments, any number of two or more applications may function within a device with concurrent data streams.

In step S**210**, the sensor addressing module **160** may receive any data requests, and identify appropriate sensor data for responding to each request. Such identification may simply identify an output register identified by the application, or may match provided parameters with available data streams. In step S**212**, any necessary updates to calibration selections (relating to e.g. biases and scale factors), data rates, frequency filters, or any other settings may be updated for a particular data stream based on a data request. In step S**214**, after the appropriate data streams are set based on the requested parameters, sensor addressing module **160** may concurrently route the data stream to the corresponding appropriate application. For example, if digital filter **130***d* and calibration module **140***d* are set using parameters provided by application **190***a*, and if digital filter **130***a* and calibration module **140***a* are set to match parameters provided by application **190***b*, then the data from output register **150***d* may be sent to application **190***a* concurrently with the data from output register **150***a* being sent to application **190***b*.

Such a system may operate with a first data stream being sent continuously, while a second data stream starts and stops repeatedly in response to various application requests. Such a system may further operate with any number of additional data streams being sent concurrently, and with additional data streams starting and ending while other data streams operate, with each data stream having a different set of parameters. Further, in certain embodiments, certain applications may be sent the same data stream or different data streams having the same parameters, while multiple additional applications receive a concurrently transmitted data stream having different parameters.

In various alternative embodiments, a combination of parameters such as a data rate, inclusion of calibration parameters, and adjustment of dynamic value ranges, a data rate, a data calibration, a data output range, a data output resolution, a sampling rate, a measurement range, a filtering frequency, or any other such parameter may be used. Such parameters may be set by digital filter **230***b*, calibration module **240**, or any other additional module.

An additional potential example of an embodiment may now be described. In one potential embodiment, sensor addressing module **160** may contain information that the data stream associated with output register **150***a* includes calibrated data with a sampling rate of 20 Hz and output register **150***b* includes uncalibrated data with a sampling rate of 100 Hz. If an application **190***c* requests calibrated data at a sampling rate of 20 Hz, the information from output register **150***a* by simply be sent to application **190***c*. If application **190***d* requests uncalibrated data at 200 Hz, the digital filter **130***b* may be modified to adjust the sampling rate, and when the data in output register **150***b* has been adjusted to match the parameter request from application **190***d*, the data may be sent to application **190***d*.

As described by FIG. **2**, one potential implementation of negotiating parameters for an application requesting sensor data is to query a sensor module for available streams. In various alternative embodiments, an application may send a request for a data stream having certain parameters. The sensor addressing module may receive such a request, and identify whether a stream with current parameters equal to the requested parameters exist. If a data stream with currently parameters equal to the requested parameters does exist, the sensor addressing module may respond either by communicating the data stream to the application, or by identifying the data stream. The parameters for that data stream may then be fixed until released by the application. Alternatively, a communication may be sent to the application prior to a later update of the parameters for that data stream, indicating that the data stream will no longer match the requested parameters.

If a data stream having current parameters equal to the requested parameters does not exist, the sensor addressing module may identify an available data stream and communicate with the filters and/or calibration modules associated with that data stream to update the data stream to parameters that match the requested data stream. The data stream or an identifier associated with the data stream may then be sent to the requesting application. If all data streams are in use and none of the data streams match the requested data stream parameters, an indication that no data stream is available may be sent in response to the request for the data stream having the set of data stream parameters.

Referring to FIG. **3**, one particular embodiment of a sensor optimizer is illustrated. Device **200** includes sensor module **202**, sensor optimizer **203**, and applications **290***a-d*. The embodiment of sensor optimizer shown as sensor optimizer **203** comprises signal multiplexing module **220**, digital filters **230***a-d*, calibration modules **240***a-d*, output registers **250***a-d*, and sensor addressing module **260**. Although four digital filters **230**, four calibration modules **240**, and four output registers **250** are shown, any number of two or more of some elements may be present in accordance with the various embodiments. Similarly, although four applications are shown in FIG. **3**, any number applications may function in accordance with various embodiments as the application or applications request and receive at least two concurrent sensor data streams from a single sensor module.

Sensor module **202** may be any sensing device integrated with device **200**. For example, a sensor element may be a gyroscope, an accelerometer, a magnetometer, a charge coupled device (CCD), a photovoltaic cell, any light sensing device, a temperature sensing device, a pressure sensing device, or any other potential sensing device or element.

Signal multiplexing module **220** may convert sensor data from sensor element **210** into multiple streams of data for use by multiple digital filters **230** as separate signals.

Digital filters **230** may comprise hardware digital filters that may be configurable to adjust various parameters of a data stream associated with each corresponding digital filter **230**. For example, a filtering frequency may be set by digital filter, along with a sampling rate and measurement rage. Such settings may be communicated directly to digital filter **230** by sensor addressing module, or may be communicated to digital filter **230** by any appropriate signal path. In various embodiments, digital filters **230** may alternatively comprise firmware, hardware, software, or any combination in or to implement any kind of digital manipulation or digital processing on a sensor source data stream.

Calibration modules **240** may function to modify various data streams with calibration data. In one potential embodiment, each calibration module **240** comprises a memory that stores calibration data. Such calibration data may be created as part of an operation of a device, where a known input is provided to sensor element **210**, and the output of sensor element **210** is compared with the values of the known input to create calibration data. The calibration data may then be stored for use by calibration modules **240**. Similar to the function of digital filters **230**, calibration modules **240** may have an input to receive a command directly from sensor addressing module **260** to modify an associated data stream using the calibration data or not to modify the associated data stream using the calibration data. Such an input may comprise a direct signal from sensor addressing module **260**, or an input via any other possible path for a command input to calibration module **240**. In various embodiments, calibration modules **240** may be implemented in hardware, firmware, software, or any combination of these. Calibration modules **240** may thus be implemented using memory that stores calibration data, and may further comprise or be connected to one or more processors that use the calibration data to create a calibrated data stream from a source data stream.

In various embodiments, calibration data may be created in a factory setting, where all units are compared with a known sensing target in order to compensate for variations in sensor output measurements when a sensor optimizer is in a device with sensor modules. In alternate embodiments, a device user may perform a calibration routine as part of a calibration application in the device to update calibration parameters. In still further embodiments, a device may include automated calibration routines that continuously or periodically implement an automated calibration or calibration update to create a real or near real-time calibration.

Output data register **250** may then store data for an associated data stream from the respective digital filter **230** and calibration module **240**. Such a register may be any acceptable data storage device or memory. When an application **290** requests information from sensor element **210**, it may request such information by directly addressing a specific output register **250** in a communication with sensor addressing module **260**, or it may simply request a data stream with a set group of parameters, and allow sensor addressing module **260** to request data from an output register **250** after verifying that digital filter **230** and calibration module **240** for the corresponding output register **250** match the parameters as closely as possible. In certain embodiments, the sensor optimizer may "spoof" a sensor module, such that when a processor communicates a message to a sensor module, the sensor optimizer may intercept the request as discussed above. In the example of FIG. **3**, the sensor addressing module may intercept the request from an application operating on the processor, and then may communicate a request for a source sensor data stream to the sensor module **202**. In certain embodiments, a sensor optimizer application executed by a processor may operate in conjunction with sensor optimizer **303** to facilitate interception of requests for sensor data.

In additional alternative embodiments, sensor addressing module **260** may further include elements for creation of additional data streams. For example, if six different data streams are requested from the sensor element **210**, addressing module **260** may comprise firmware, hardware, or software for creating additional data streams from the data streams in output data registers **250**. Sensor addressing module may further be able to create multiple output streams from a single stream in an output data register, and modify one or more of the multiple data streams by adjusting a calibration, a sampling rate, a bandwidth, or any other such data stream parameter. In such embodiments, a sensor addressing module **260** may include or be connected to a memory element or memory module that stores calibration data, and may further include or be connected to a processing element or processing module. Sensor addressing module may then output multiple data streams with different parameters using a data stream from a single output data register such as output data register **250***a*.

FIG. **4** describes another example of a device according to another potential embodiment. Device **300** of FIG. **3** includes a first sensor module **301**, a second sensor module **302**, a sensor optimizer **303**, a processor **398**, and a memory **396**. Sensor optimizer **303** includes signal multiplexing module **320**, digital filters **330***a-d*, calibration modules **340***a-d*, and output registers **350***a-d*. Sensor module **301** and sensor module **302** may be different types of sensor modules. For example, sensor module **301** may function as a gyroscope module and sensor module **302** may function as a camera module. In alternate embodiments, these sensor modules may be redundant modules that perform the same function.

In the embodiment of FIG. **4**, sensor multiplexing module **320** may serve a dual function of creating multiple sensor data streams from a single source data stream, and may also function as a switch to select different source data streams from different sensor modules for different circuitry paths associated with an output register. Thus, for example, if three sensor data streams are requested from sensor module **301** by applications operating on processor **398** and one sensor data stream is request from sensor module **302**, signal multiplexing module **320** may create three sensor data streams **323**, **324**, and **325** from source data stream **311** and a single sensor data stream **322** from source data stream **312**. The various sensor data streams **322-325** may then be modified by corresponding digital filters **330** and calibration modules **340** to match sensor stream parameters requested by the processor, before being buffered at output registers **350** for communication to processor **398** via sensor addressing module **360**.

In the embodiment of FIG. **3**, signal sensor addressing module **360** routes sensor data and requests for sensor data between sensor module **301** and **301** and processor **398**. Thus in certain embodiments, a single sensor optimizer may function to enable addressing and data stream creation for multiple sensor modules. In alternate embodiments, each sensor module may have a separate sensor optimizer or groups of sensor modules may be associated with different sensor optimizers in any potential combination.

Further, as shown by FIG. **3**, applications **390***a*, **390***b*, and **390***c* operate as executed by processor **398** in conjunction with non-transitory storage memory **396**. Such applications may function as executed by processor **398** to request sensor data from sensor modules **300** and **400**, and may store such sensor data for use within memory **396** as part of each application. In one potential embodiment, an application executed by processor **398** may function in conjunction with sensor optimizer **303** to manage interception of requests for sensor data, to manage the requests for different sensor stream parameters, and to managing conflicting or excessive numbers of requests for sensor data.

FIG. **3** further shows signal paths for sensor data and sensor data streams derived from sensor modules **301** and **302**. For example, source data streams **311** is received at signal multiplexing module **320** from sensor **301**, and source data stream **312** is received at signal multiplexing module **320** from sensor module **320**. These source data streams may be output from the sensor modules in response to a request received at the sensor module from the processor in conjunction with an application managing a sensor optimizer, in response to a request from sensor addressing module **360**, or in response to a communication along a sensor data stream path such as the path from output register **350** to sensor module **301** via signal multiplexing module **320**, digital filter **330***a*, and calibration module **340***a*. Signal multiplexing module **320** outputs sensor data streams **322**, **323**, **324**, and **325**, which may be created using any combination of source data streams **311** and **312**.

Signal multiplexing module **320** may essentially be considered as outputting data streams along separate hardware or circuitry paths, each of which has an output register **350** for storing and managing output of a sensor data stream. While filtering and calibration adjustments may be made to a particular sensor data stream prior to that stream being managed by an output register, the signal received at the register is still considered to be the same sensor data stream despite any changes made to set certain data stream parameters on the sensor data stream.

For example as shown in FIG. **4**, sensor data stream **322** may be modified by digital filter **330***d* to create a filtered sensor data stream **332**, which may further be modified by calibration module **340***d* to create a calibrated sensor data stream **342** which is input to output register **350***d*, but the calibrated filtered sensor data stream received at output register **350** is still considered to be sensor data stream **322**.

Just as for other embodiments, while the example shown in FIG. **4** includes a calibration module and digital filter for each circuitry path, any combination of modules and paths may be present in alternative embodiments to enable concurrent output of at least a portion of first and second data streams from a single sensor module having different data stream parameters.

FIG. **5** is block diagram illustrating one potential embodiment of a mobile device that may be used in conjunction with embodiments described herein. Such mobile devices include sensor modules and one or more sensor optimizers to enable a single sensor module to output concurrent sensor data streams having different data stream parameters. Such a mobile device may also execute applications as described in conjunction with various embodiments, such that the applications may request sensor data having different data stream parameters from a single sensor module. Mobile device **500** of FIG. **5** may be any mobile device such as a smart phone, cellular phone, personal digital assistant, tablet computer, personal media player as well as any other type of portable electronic device offering similar or combined functionality. It should be appreciated that device **500** may also include tactile buttons, a power device (e.g., a battery), as well as other components associated with a portable electronic device such as a smart cellular telephone. Accordingly, FIG. **5** is not to be construed as limiting because some components are omitted.

In the embodiment shown at FIG. **5**, device **500** includes processor **510** configured to execute instructions for performing operations at a number of components and can be, for example, a general-purpose processor or microprocessor suitable for implementation within a portable electronic device. Processor **510** is communicatively coupled with a plurality of components within mobile device **500**. To realize this communicative coupling, processor **510** may communicate with the other illustrated components across a bus **540**. Bus **540** can be any subsystem adapted to transfer data within mobile device **500**. Bus **540** can be a plurality of computer buses and include additional circuitry to transfer data.

Memory **520** may be coupled to processor **510**. In some embodiments, memory **520** offers both short-term and long-term storage and may in fact be divided into several units. Memory **520** may be volatile, such as static random access memory (SRAM) and/or dynamic random access memory (DRAM) and/or non-volatile, such as read-only memory (ROM), flash memory, and the like. Furthermore, memory **520** can include removable storage devices, such as secure digital (SD) cards. Thus, memory **520** provides storage of computer readable instructions, data structures, program modules, and other data for mobile device **500**. In some embodiments, memory **520** may be distributed into different hardware modules.

Mobile device **500** includes sensor optimizer **505** that may intercept requests from application modules **521**A-N being executed by processor **510** as the application modules make requests for sensor data from sensor modules **501**A-Z. Additionally, as described above, an application modules **521** may include a sensor optimizer application module that may function in conjunction with sensor optimizer **505** to enable interception of requests for sensor data, to assist in addressing particular sensor data streams with particular data stream parameters, and to manage to available sensor data streams from one or more sensor modules **501** in conjunction with sensor optimizer **505**.

In some embodiments, memory **520** stores a plurality of application modules **521**A-N. Application modules **521**A-N contain particular instructions to be executed by processor **510**. Memory **520** can store any number of application modules. A respective one of application modules **521**A-N can be, for example, a calendar application, a geo-fencing application, a power management application, a smart alert application, a social media application (e.g., Twitter™ or Facebook™), or any application-type module having instructions to be executed by processor **510**. Any such applications may access sensor data by communicating a request for sensor data or a sensor data stream to a sensor addressing module. In some embodiments, memory **520** includes an operating system **523**. Operating system **523** may be operable to initiate the execution of the instructions provided by application modules **521**A-N and/or manage sensor modules **501**. Operating system **523** may be adapted to perform other operations across the components of device **500** including threading, resource management, data storage control and other similar functionality.

In some embodiments, mobile device **500** includes one or more wireless modules **512**. Wireless modules **512** may include a Wi-Fi transceiver, a transceiver for communicating

with cellular telephone towers, or any other such module for implementing wireless communications.

Additionally, in some embodiments, mobile device **500** includes a plurality of sensor modules **501**A-**501**Z. Each sensor module **501** is a physical module within device **500**. However, while each of modules **501** is permanently configured as a structure, a respective one of modules **501** may be temporarily configured to perform specific functions or temporarily activated. A common example is an application module that may program a camera module (i.e., sensor module) for shutter release and image capture that is activated for image capture and deactivated after image capture, or activated for creation of a sensor data stream in the form of a video capture stream, and deactivated when capture of the video data is complete. Further, in addition to sensor modules **501**, and number of additional hardware modules with particular functionality may be included within mobile device **500**. A respective one of modules **501** can be, for example, an accelerometer, a satellite navigation system receiver (e.g., a GPS module), a pressure module, a temperature module, an audio output and/or input module (e.g., a microphone), a camera module, a proximity sensor, an alternate line service (ALS) module, a capacitive touch sensor, a near field communication (NFC) module, a Bluetooth transceiver, a cellular transceiver, a magnetometer, a gyroscope, an inertial sensor (e.g., a module the combines an accelerometer and a gyroscope), an ambient light sensor, a relative humidity sensor, or any other similar module operable to provide sensory output and/or receive sensory input. In some embodiments, one or more functions of the sensor modules **501** may be implemented in software.

In addition to sensor modules **501** and application modules **521**A-N, mobile device **500** may have a display module **503** and a user input module **504**. Display module **503** graphically presents information from device **500** to the user. This information may be derived from one or more application modules **521**A-N, one or more sensor modules **501**, a combination thereof, or any other suitable means for resolving graphical content for the user (e.g., by operating system **524**). Display module **503** can be liquid crystal display (LCD) technology, light emitting polymer display (LPD) technology, or some other display technology. In some embodiments, display module **503** is a capacitive or resistive touch screen and may be sensitive to haptic and/or tactile contact with a user. In such embodiments, the display module **503** can comprise a multi-touch-sensitive display.

Additional embodiments of a mobile device may further comprise various portions of computing devices as are detailed below with respect to FIG. **7**.

FIG. **6** describes an additional alternative method according to a potential embodiment. In S**610**, a sensor optimizer receives, a first request from a processor for sensor data from a first sensor element, the first request for sensor data identifying a first set of data stream parameters. In S**612**, the sensor optimizer receives a second request for sensor data from the first sensor element, the second request identifying a second set of data stream parameters that are different from the first set of data stream parameters.

In S**614**, the sensor optimizer requests a source data stream from the sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters. In S**616**, the sensor optimizer creates a first sensor data stream from the source data stream, where the first sensor data stream conforms to the first set of data stream parameters.

In S**618** the sensor optimizer creates a second sensor data stream from the source data stream, where the second sensors data stream conforms with the second set of data stream parameters. In S**620**, the sensor optimizer concurrently communicates the first sensor data stream and the second sensor data stream to a processor.

An example of a computing system in which various aspects of a device having one or more sensor elements and that operates a plurality of applications concurrently may be implemented will now be described with respect to FIG. **7**. According to one or more aspects, a computer system as illustrated in FIG. **7** may be incorporated as part of a computing device, which may implement, perform, and/or execute any and/or all of the features, methods, and/or method steps described herein. For example, computer system **700** may represent some of the components of a hand-held device. A hand-held device may be any computing device with an input sensory unit, such as a camera and/or a display unit. Examples of a hand-held device include but are not limited to video game consoles, tablets, smart phones, televisions, and mobile devices. In one embodiment, the system **700** is configured to implement any of the methods described above. FIG. **7** provides a schematic illustration of one embodiment of a computer system **700** that can perform the methods provided by various other embodiments, as described herein, and/or can function as the host computer system, a remote kiosk/terminal, a point-of-sale device, a mobile device, a set-top box, and/or a computer system. FIG. **7** is meant only to provide a generalized illustration of various components, any and/or all of which may be utilized as appropriate. FIG. **7**, therefore, broadly illustrates how individual system elements may be implemented in a relatively separated or relatively more integrated manner.

The computer system **700** is shown comprising hardware elements that can be electrically coupled via a bus **705** (or may otherwise be in communication, as appropriate). The hardware elements may include one or more processors **710**, including without limitation one or more general-purpose processors and/or one or more special-purpose processors (such as digital signal processing chips, graphics acceleration processors, and/or the like); one or more input devices **715**, which can include without limitation a camera, a mouse, a keyboard and/or the like; and one or more output devices **720**, which can include without limitation a display unit, a printer and/or the like. In some embodiments, the one or more processor **710** may be configured to perform a subset or all of the functions described above with respect to FIGS. **1** and **2**. For example, as described above any combination of applications **190***a-d* may be implemented using one or more processors **710**. The processor **710** may comprise a general processor and/or and application processor, for example. In various embodiments, the processor is integrated into an element that processes camera inputs, gyroscope inputs, or other sensor element input that may be modified by additional elements such as analog to digital converters or digital data outputs such as digital data output **120**.

The computer system **700** may further include (and/or be in communication with) one or more non-transitory storage devices **725**, which can comprise, without limitation, local and/or network accessible storage, and/or can include, without limitation, a disk drive, a drive array, an optical storage device, a solid-state storage device such as a random access memory ("RAM") and/or a read-only memory ("ROM"), which can be programmable, flash-updateable and/or the like. Such storage devices may be configured to implement any appropriate data storage, including without limitation, various file systems, database structures, and/or the like.

The computer system **700** might also include a communications subsystem **730**, which can include without limitation a modem, a network card (wireless or wired), an infrared communication device, a wireless communication device and/or chipset (such as a Bluetooth® device, an 802.11 device, a WiFi device, a WiMax device, cellular communication facilities, etc.), and/or the like. The communications subsystem **730** may permit data to be exchanged with a network (such as the network described below, to name one example), other computer systems, and/or any other devices described herein. In many embodiments, the computer system **700** will further comprise a non-transitory working memory **735**, which can include a RAM or ROM device, as described above.

The computer system **700** also can comprise software elements, shown as being currently located within the working memory **735**, including an operating system **740**, device drivers, executable libraries, and/or other code, such as one or more application programs **745**, which may comprise computer programs provided by various embodiments, and/or may be designed to implement methods, and/or configure systems, provided by other embodiments, as described herein. Merely by way of example, one or more procedures described with respect to the method(s) discussed above, for example as described with respect to FIG. **2**, might be implemented as code and/or instructions executable by a computer (and/or a processor within a computer); in an aspect, then, such code and/or instructions can be used to configure and/or adapt a general purpose computer (or other device) to perform one or more operations in accordance with the described methods. The processor **710**, memory **735**, operating system **740**, and/or application programs **745** may be used to implement various blocks described with respect to FIGS. **1-2**.

A set of these instructions and/or code might be stored on a computer-readable storage medium, such as the storage device(s) **725** described above. In some cases, the storage medium might be incorporated within a computer system, such as computer system **700**. In other embodiments, the storage medium might be separate from a computer system (e.g., a removable medium, such as a compact disc), and/or provided in an installation package, such that the storage medium can be used to program, configure and/or adapt a general purpose computer with the instructions/code stored thereon. These instructions might take the form of executable code, which is executable by the computer system **700** and/or might take the form of source and/or installable code, which, upon compilation and/or installation on the computer system **700** (e.g., using any of a variety of generally available compilers, installation programs, compression/decompression utilities, etc.) then takes the form of executable code.

Substantial variations may be made in accordance with specific requirements. For example, customized hardware might also be used, and/or particular elements might be implemented in hardware, software (including portable software, such as applets, etc.), or both. Further, connection to other computing devices such as network input/output devices may be employed.

Some embodiments may employ a computer system (such as the computer system **700**) to perform methods in accordance with the disclosure. For example, some or all of the procedures of the described methods may be performed by the computer system **700** in response to processor **710** executing one or more sequences of one or more instructions (which might be incorporated into the operating system **740** and/or other code, such as an application program **745**) contained in the working memory **735**. Such instructions may be read into the working memory **735** from another computer-readable medium, such as one or more of the storage device(s) **725**. Merely by way of example, execution of the sequences of instructions contained in the working memory **735** might cause the processor(s) **710** to perform one or more procedures of the methods described herein, for example methods described with respect to FIGS. **1-2**.

The terms "machine-readable medium" and "computer-readable medium," as used herein, refer to any medium that participates in providing data that causes a machine to operate in a specific fashion. In an embodiment implemented using the computer system **700**, various computer-readable media might be involved in providing instructions/code to processor(s) **710** for execution and/or might be used to store and/or carry such instructions/code (e.g., as signals). In many implementations, a computer-readable medium is a physical and/or tangible storage medium. Such a medium may take many forms, including but not limited to, non-volatile media, volatile media, and transmission media. Non-volatile media include, for example, optical and/or magnetic disks, such as the storage device(s) **725**. Volatile media include, without limitation, dynamic memory, such as the working memory **735**. Transmission media include, without limitation, coaxial cables, copper wire and fiber optics, including the wires that comprise the bus **705**, as well as the various components of the communications subsystem **730** (and/or the media by which the communications subsystem **730** provides communication with other devices). Hence, transmission media can also take the form of waves (including without limitation radio, acoustic and/or light waves, such as those generated during radio-wave and infrared data communications).

Common forms of physical and/or tangible computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, or any other magnetic medium, a CD-ROM, any other optical medium, punchcards, papertape, any other physical medium with patterns of holes, a RAM, a PROM, EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave as described hereinafter, or any other medium from which a computer can read instructions and/or code.

Various forms of computer-readable media may be involved in carrying one or more sequences of one or more instructions to the processor(s) **710** for execution. Merely by way of example, the instructions may initially be carried on a magnetic disk and/or optical disc of a remote computer. A remote computer might load the instructions into its dynamic memory and send the instructions as signals over a transmission medium to be received and/or executed by the computer system **700**. These signals, which might be in the form of electromagnetic signals, acoustic signals, optical signals and/or the like, are all examples of carrier waves on which instructions can be encoded, in accordance with various embodiments of the invention.

The communications subsystem **730** (and/or components thereof) generally will receive the signals, and the bus **705** then might carry the signals (and/or the data, instructions, etc. carried by the signals) to the working memory **735**, from which the processor(s) **710** retrieves and executes the instructions. The instructions received by the working memory **735** may optionally be stored on a non-transitory storage device **725** either before or after execution by the processor(s) **710**.

The methods, systems, and devices discussed above are examples. Various embodiments may omit, substitute, or add various procedures or components as appropriate. For

instance, in alternative configurations, the methods described may be performed in an order different from that described, and/or various stages may be added, omitted, and/or combined. Also, features described with respect to certain embodiments may be combined in various other embodiments. Different aspects and elements of the embodiments may be combined in a similar manner. Also, technology evolves and, thus, many of the elements are examples that do not limit the scope of the disclosure to those specific examples.

Specific details are given in the description to provide a thorough understanding of the embodiments. However, embodiments may be practiced without these specific details. For example, well-known circuits, processes, algorithms, structures, and techniques have been shown without unnecessary detail in order to avoid obscuring the embodiments. This description provides example embodiments only, and is not intended to limit the scope, applicability, or configuration of the invention. Rather, the preceding description of the embodiments will provide those skilled in the art with an enabling description for implementing embodiments of the invention. Various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the invention.

Also, some embodiments were described as processes depicted as flow diagrams or block diagrams. Although each may describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations may be rearranged. A process may have additional steps not included in the figure. Furthermore, embodiments of the methods may be implemented by hardware, software, firmware, middleware, microcode, hardware description languages, or any combination thereof. When implemented in software, firmware, middleware, or microcode, the program code or code segments to perform the associated tasks may be stored in a computer-readable medium such as a storage medium. Processors may perform the associated tasks.

Having described several embodiments, various modifications, alternative constructions, and equivalents may be used without departing from the spirit of the disclosure. For example, the above elements may merely be a component of a larger system, wherein other rules may take precedence over or otherwise modify the application of the invention. Also, a number of steps may be undertaken before, during, or after the above elements are considered. Accordingly, the above description does not limit the scope of the disclosure.

What is claimed is:

1. A method comprising:

receiving a first request from a processor for calibrated sensor data from a first sensor element, the first request for the calibrated sensor data identifying a first set of data stream parameters;

receiving a second request for uncalibrated sensor data from the first sensor element, the second request for the uncalibrated sensor data identifying a second set of data stream parameters that are different from the first set of data stream parameters;

in response to receiving both the first and second requests, requesting a source data stream from the first sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters;

creating a first sensor data stream from the source data stream, wherein the first sensor data stream conforms to the first set of data stream parameters and comprises the calibrated sensor data;

creating a second sensor data stream from the source data stream, wherein the second sensor data stream conforms to the second set of data stream parameters and comprises the uncalibrated sensor data; and

concurrently communicating the first sensor data stream and the second sensor data stream to the processor.

2. The method of claim **1** wherein the first request for the calibrated sensor data is received from a first application operating on the processor and wherein the second request for the uncalibrated sensor data is received from the first application operating on the processor.

3. The method of claim **1** wherein the first request for the calibrated sensor data is received from a first application operating on the processor and wherein the second request for the uncalibrated sensor data is received from a second application operating on the processor.

4. The method of claim **3** wherein the first application comprises a camera application and the second application comprises a navigation application.

5. The method of claim **4** wherein the first sensor element comprises a gyroscope.

6. The method of claim **3** wherein the first sensor element comprises an accelerometer.

7. The method of claim **6** wherein the first application comprises a user interface orientation control application and wherein the second application comprises a navigation application.

8. The method of claim **3** wherein creating the first sensor data stream and the second sensor data stream comprises:

receiving the source data stream from the first sensor element at a signal multiplexer;

outputting the first sensor data stream from the signal multiplexer to a first output register; and

outputting the second sensor data stream from the signal multiplexer to a second output register.

9. The method of claim **8** wherein concurrently communicating the first sensor data stream to the first application and the second sensor data stream to the second application comprises:

communicating the first sensor data stream from the first output register to the first application of the processor via a sensor addresser beginning at a first time and ending at a second time; and

communicating the second sensor data stream from the second output register to the second application of the processor via the sensor addresser beginning at a third time and ending at a fourth time, wherein the third time is later than the first time and the third time is earlier than the second time.

10. The method of claim **1** wherein the first request for the calibrated sensor data is received from a first application operating on the processor and wherein the second request for the uncalibrated sensor data is received from a second application operating on a second processor within a mobile device that comprises the processor.

11. A device comprising:

a first sensor comprising a first sensor element;

a sensor optimizer coupled to the first sensor; and

a processor coupled to the first sensor via the sensor optimizer;

wherein the sensor optimizer is configured to:

receive first and second requests for sensor data from the first sensor, the first and second requests for sensor data identifying first and second sets of data stream parameters, the first request for sensor data comprising a request for calibrated sensor data, and

the second request for sensor data comprising a request for uncalibrated sensor data;

in response to receiving the respective requests, request a source data stream from the first sensor element, using a source set of parameters based on the first and second sets of data stream parameters; and

receive a source sensor data stream from the first sensor; and

concurrently output to the processor at least two sensor data streams derived from the source sensor data stream, a first sensor data stream comprising the calibrated sensor data and a second sensor data stream comprising the uncalibrated sensor data.

12. The device of claim **11** wherein the sensor optimizer comprises:

a plurality of digital filters coupled to the first sensor element by a signal multiplexer;

a plurality of output registers, each output register coupled to one corresponding digital filter of the plurality of digital filters; and

a sensor addresser coupled to the plurality of output registers.

13. The device of claim **12** wherein the sensor optimizer further comprises a first calibration module;

wherein the plurality of digital filters comprises a first digital filter and a second digital filter;

wherein the processor executes a plurality of applications, each application of the plurality of applications providing a set of data stream parameters to the processor for communication to the sensor addresser as part of a request for sensor data by each application of the plurality of applications;

wherein the plurality of output registers comprises a first output register coupled to the first digital filter and a second output register coupled to the second digital filter; and

wherein the first digital filter is coupled to the first output register via the first calibration module.

14. A device comprising:

means for receiving first and second requests for sensor data from a first sensor, the first and second requests for sensor data identifying first and second sets of data stream parameters, the first request for sensor data comprising a request for calibrated sensor data, and the second request for sensor data comprising a request for uncalibrated sensor data;

means for requesting a source data stream from the first sensor, using a source set of parameters based on the sets of data stream parameters in response to receiving the respective requests;

means for receiving a source sensor data stream from a sensor;

means for creating at least two different sensor data streams derived from the source sensor data stream; and

means for concurrently outputting the at least two different sensor data streams to a processor, a first sensor data stream comprising the calibrated sensor data and a second sensor data stream comprising the uncalibrated sensor data.

15. The device of claim **14** further comprising:

means for intercepting requests for sensor data streams from the processor to the sensor; and

means for adjusting a set of sensor stream parameters for each sensor data stream to match requested sensor stream parameters from the intercepted requests for sensor data streams.

16. The device of claim **14** further comprising:

means for receiving a second source data stream from a second sensor;

means for creating second at least two different sensor data streams derived from the second source sensor data stream; and

means for concurrently outputting the second at least two different sensor data streams to the processor.

17. A non-transitory computer readable storage medium comprising computer readable instructions that, when executed by a processor coupled to the storage medium, cause a device to:

communicate from the processor to a sensor optimizer, a first request for calibrated sensor data from a first sensor element, the first request for the calibrated sensor data identifying a first set of data stream parameters;

communicate from the processor to the sensor optimizer, a second request for uncalibrated sensor data from the first sensor element, the second request for the uncalibrated sensor data identifying a second set of data stream parameters that are different from the first set of data stream parameters;

in response to receiving both the first and second requests, request, by the sensor optimizer, a source data stream from the first sensor element, using a source set of parameters based on the first set of data stream parameters and the second set of data stream parameters;

create, by the sensor optimizer, a first sensor data stream from the source data stream, wherein the first sensor data stream conforms to the first set of data stream parameters and comprises the calibrated sensor data;

create, by the sensor optimizer, a second sensor data stream from the source data stream, wherein the second sensor data stream conforms with the second set of data stream parameters and comprises the uncalibrated sensor data; and

concurrently receive at the processor the first sensor data stream and the second sensor data stream.

18. The non-transitory computer readable storage medium of claim **17** further comprising computer readable instructions that cause the device to:

execute, by the processor, a first application that initiates the first request for calibrated sensor data; and

execute, by the processor, a second application concurrent with the execution of the first application, wherein the second application initiates the second request for uncalibrated sensor data.

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